# CBIR Using Kekre's Transform over Row column Mean and Variance Vectors

Dr. H. B. Kekre Kavita Sonavane

***Abstract*—We see the advancement in image acquisition technologies and storage systems which always encourages us to design a sophisticated system to retrieve the images effectively. In this paper, we describe the novel approach for image retrieval based on image contents. It involves creation of feature database for all database images which includes formation of feature vector by applying the two methods one is by applying Kekre's transform over row and column vectors and secondly by applying Kekre's transform over row - column variance vectors of image. Further we apply a similarity measure to compare the query image and the database images. Finally we retrieve similar images from database based on the pre determined threshold. The database of 525 images of seven different categories (75 from each category) is used for demonstration to compare the performance of these algorithms using precision and recall as parameters.**

***Keywords-component; Image retrieval, Kekre's Transform, variance, image database, precision, recall***

## I. INTRODUCTION

This paper describes the simple and new approach to create the feature vector database and retrieval of images from database similar to the query image. We first create a feature database for all images in the database which is the preprocessing part of this work. The formation of feature vector is core process of any CBIR system [1], [2], [3], [6], [7]. In this paper First we split the image into R, G and B planes [4], [5], [11], [12]. For each of these three planes we are calculating mean vectors for row and columns of images over which we applied Kekre's transformation and obtained the feature database for first approach and in second approach we calculated the variances of row and column vectors which is followed by the application of Kekere' transform to obtain set of coefficients which creates the feature vector database for the second approach. In first feature database1 we have six feature vectors (RRK, RCK, GRK, GCK, BRK and BCK ) for each of the 525 images. In feature database2 we have six feature vectors (RRVK, RCVK, GRVK, GCVK, BRVK and BCVK) for each of the 525 images.

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Each feature vector in FDB1 and FDB2 represents the row and column mean and variance Kekre's transform coefficients respectively for planes R, G and B of an image. Whenever we give a query image as query by example to our system, it calculates the feature vectors in the similar manner as explained above. Next step the system performs is the comparison of query image with database images using the similarity measure Euclidean distance [19]. Once we have calculated the Euclidean distance between query and database images we retrieve the image from Image database where the Euclidean distance is less than preselected threshold. Determination of threshold is trial and error method.

The motivation for this work is the use of color feature and texture feature in approach 1 and 2 and their performance comparison [8], [17], [18].

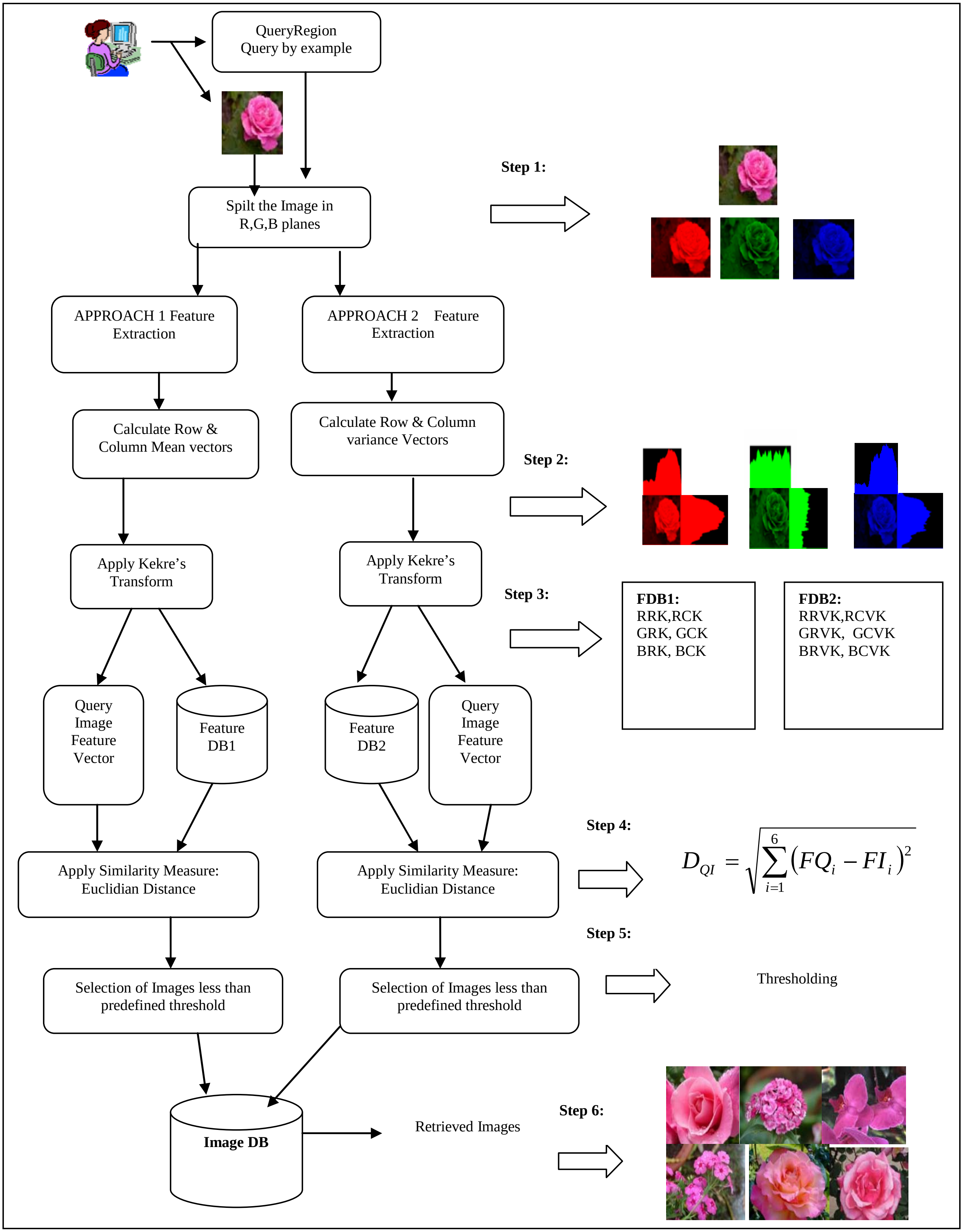
The organization of the paper is as follows. In section 2 and section 3 algorithmic view of Approach 1 and 2 is explained with implementation details respectively. Section 4 presents Determinations of threshold. Experimental results and discussion with the comparative study of both approaches is given in Section 5. Finally the work presented is concluded in section 6.

## II. ALGORITHMIC VIEW WITH IMPLEMENTATION DETAILS FOR APPROACH 1 AND 2

### A. *Kekre's Transform over Row/Column Mean Vectors*

First approach is "Kekre's transform over row and column mean vectors of images" and second is "Kekre's transform over variances of row and column vectors of images". For both approaches query is given by example query image.

Feature extraction is done in the following way; For approach1, image for which the feature vector is to be calculated is splited into R, G and B color components and for each of these three components row and column mean vectors are computed over which Kekre's transform is applied to obtain the coefficients to form the feature vectors (RRK, RCK GRK, GCK and BRK, BCK for R, G and B planes respectively and a feature database FDB1 is formed for all database images as explained below in steps 1 to 3 [5], [7], [8], [9], [10],[13],[14], [15], [16].


QueryRegion
Query by example
Step 1:
Spilt the Image in R,G,B planes
APPROACH 1 Feature Extraction
APPROACH 2 Feature Extraction
Calculate Row & Column Mean vectors
Calculate Row & Column variance Vectors
Step 2:
Apply Kekre's Transform
Apply Kekre's Transform
Step 3:
FDB1:
RRK,RCK
GRK, GCK
BRK, BCK
FDB2:
RRVK,RCVK
GRVK, GCVK
BRVK, BCVK
Query Image Feature Vector
Feature DB1
Feature DB2
Query Image Feature Vector
Step 4:
$D_{QI} = \sqrt{\sum_{i=1}^{6} (FQ_i - FI_i)^2}$
Apply Similarity Measure: Euclidian Distance
Apply Similarity Measure: Euclidian Distance
Step 5:
Selection of Images less than predefined threshold
Selection of Images less than predefined threshold
Thresholding
Image DB
Retrieved Images
Step 6:

### *B. Kekere's Transform over Row/Column Variance vectors*

For approach 2 feature vectors are obtained almost similar to approach 1 with small change that is here feature database FDB2 is the collection of feature vectors (RRVK, RCVK, GRVK, GCVK, and BRVK, BCVK) which are obtained by applying Kekre's transform over row column variance vectors of R, G and planes of images instead of applying it over row column mean vectors as explained above in the algorithm. Upto step 3 we could obtain the two feature databases FDB 1 and FDB 2 using approach 1 and 2 respectively. Detail description for the steps 4 , 5 and 6 will be covered in Section 3 and 4.

## III. DETERMINATION OF THRESHOLD

Once we come across the comparison of query and database image features the similarity measure to be applied is selected and the threshold is determined. In our both approaches we used Euclidean distance measure to compare the feature vectors [19].

### *A.* First level thresholding:

The two feature databases obtained FDB1 and FDB2 containing the feature vectors of size six. Two components (Row and Column ) with respect to each of the three planes (R, G & B)

At this stage we tried to compare the images (Query and database image) with each of these six components separately. We have determined the threshold for each one of them in the following manner [10].

We have calculated the Euclidian distance between query image and database images which is sorted in ascending order. By taking maximum distance into consideration we selected four threshold values as follows for each component.

First, threshold we have is 10% of the maximum ED.

Second, threshold value is 20% of the maximum ED.

Third, threshold is 25% of the maximum ED and

Fourth, threshold is 30% and then 40% of the maximum ED.

Same process is used for both approaches.

After studying the result for several queries with above five threshold values we found better results at third threshold value which is 30% of Maximum Euclidean distance and selected as the standard first level threshold for both approaches.

### *B. Second Level Thresholding:*

Running the system with several queries using first level thresholding we decided to use the second level of thresholding where we can combine the six set of retrieval results obtained using previous first level threshold. In second level thresholding we are retrieving the image in final retrieval result set only if it is present in the 3 or more than 3 sets of previous retrieval results. Here we found we could improve the performance of our system using second level threshold [10].

## IV. EXPERIMENTAL RESULTS AND DISCUSSION

### *A. Database and Query Images*

The approaches discussed in section 2 and 3 have been implemented with database of 525 BMP images of seven different categories; which includes 75 Flower, 75 Sunset, 75 Barbie and 75 Mountain 75 parrot, 75 puppy and 75 Mickey images.

As per the discussion in algorithms two feature vector databases FDB1 and FDB2 are formed as preprocessing work before comparing the query image with the database images. Whenever systems gets the query image input feature vector will be calculated for the same and then we apply similarity measure Euclidian distance to compare the query image with all the database images using the predetermined First level threshold and second level threshold. Same process is used for both approaches.

These two approaches are tested using same set of query images from seven different categories. Results obtained using are evaluated using following performance evaluation criteria.

### *B. Systematic Evaluation*

A retrieved image is considered a match if it belongs to the same category of the query image.

To evaluate the performance of these image retrieval algorithms we have used two well known parameters Precision and Recall derived from all four possible outcomes of CBIR experiment as shown in Fig 2.

Precision: Precision is the fraction of the relevant images which has been retrieved (from all retrieved):

$$\text{Precision} = A / (A+B) \qquad (3)$$

Where, A is "Relevant retrieved" and

(A+B) is "All Retrieved images"

Recall: Recall is the fraction of the relevant images which has been retrieved (from all relevant):

$$\text{Recall} = A / (A+D) \qquad (4)$$

Where, A is "Relevant retrieved" and

(A+D) is "All Relevant images"

Precision and Recall are inversely related .

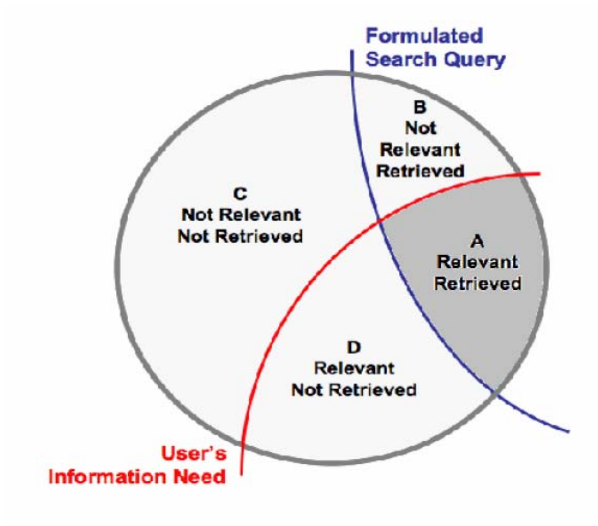



Fig2. Four Possible Outcomes of CBIR Experiment.

### *C. Results Obtained and Comparative study of two approaches*

The database used to test the performance of the system includes seven categories of images. Sample image from each one is listed in Table-I.

System is executed with 10 images from each of the seven categories and calculated the average precision and average recall parameters for all of them. The results obtained using approach1 and 2 are given in Table-II and Table-III respectively. Last row in both the tables is indicating the average precision and recall for all 70 queries from the seven categories of images in the database. Images in each of the seven categories are not closely related they all have got different look/view/ when we observe them from their low level features like shape, color and texture.

Results obtained are shown in Table-I and II for approach1 and 2 i.e kekre's transform over row column mean vectors and row column variance vectors respectively. We can observe that average precision and recall parameters in both the results are almost at same level, precision is around 0.6 where as recall is around 0.2. Both algorithms are executed with same set of query images and particularly we would like to mention here that the 10 query images selected from each of the seven categories although are not at all closely related, we could achieve very good precision. for both the algorithms.

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**Table-I**
**Representing 7 Categories of Images present in the Image Database**

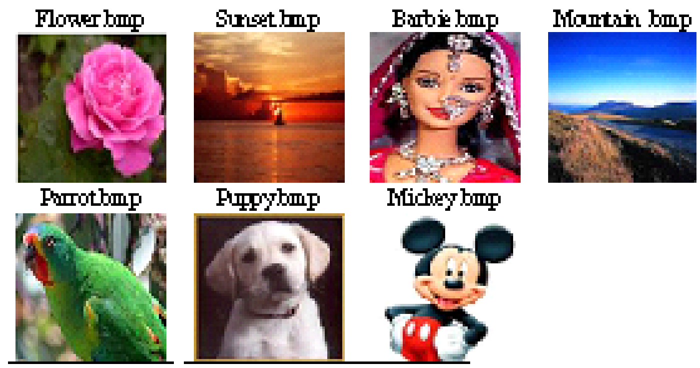



**Table-II**
**Retrieval Result for Kekre's transform over Row and column mean Vectors at 25% of Max Euclidean distance**

| Query Image | Total Retrieved Images | Relevant Retrieved Images | Precision | Recall |
|---|---|---|---|---|
| Flowers | 33 | 16 | 0.5 | 0.2 |
| Sunset | 25 | 13 | 0.63 | 0.17 |
| Barbie | 24 | 14 | 0.6 | 0.2 |
| Mountain | 37 | 21 | 0.6 | 0.3 |
| Parrot | 52 | 15 | 0.3 | 0.2 |
| Puppy | 15 | 5 | 0.5 | 0.06 |
| Mickey | 14 | 6 | 0.7 | 0.08 |
| **Total** | **204** | **90** | **3.84** | **1.21** |
| **AVERAGE PRECISION and RECALL** | | | **0.55** | **0.172** |

**Chart - I**
**Performance Evaluation of Retrieval Result for Kekre's transform over Row and column mean Vectors at 25% of Max Euclidean distance**

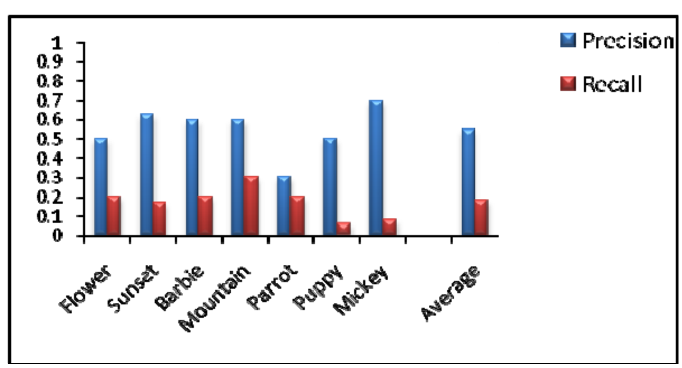
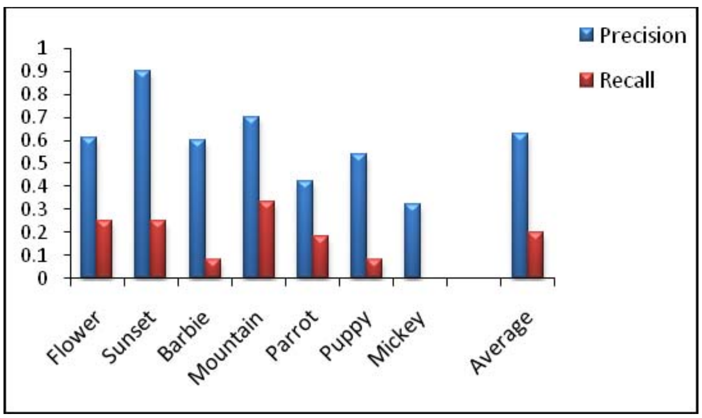


**Table-III**
**Retrieval Result for Kekre's transform over Row and column Variance Vectors at 25% of Max Euclidean distance**

| Query Image | Total Retrieved Images | Relevant Retrieved Images | Precision | Recall |
|---|---|---|---|---|
| Flowers | 22 | 18 | 0.61 | 0.25 |
| Sunset | 32 | 19 | 0.9 | 0.25 |
| Barbie | 19 | 06 | 0.6 | 0.08 |
| Mountain | 40 | 24 | 0.7 | 0.33 |
| Parrot | 36 | 13 | 0.42 | 0.18 |
| Puppy | 12 | 6 | 0.54 | 0.08 |
| Mickey | 9 | 3 | 0.32 | .0.05 |
| **Total** | **170** | **89** | **4.05** | **1.16** |
| **AVERAGE PRECISION and RECALL** | | | **0.63** | **0.2** |

**Chart - II**
**Performance Evaluation of Kekre's transform over Row and column Variance Vectors at 25% of Max Euclidean distance**




## V. CONCLUSION

Generally we see the databases selected for CBIR experiments although it includes different categories of images but each category will have almost similar images with similar background which shows better performance in most of the algorithms.

In this work we experimented with 525 image database includes seven categories. Each of these seven categories includes variety of different images with different colors, shapes, textures and different backgrounds of its own type.

Two algorithms are implemented with the application of Kekre's transform over the database images

First approach we used to form feature database FDB1 where we applied Kekre's transform over row and column mean vectors of all database images.

Similarly, feature database FDB2 is obtained by applying Kekre's transform over row column variance vectors of all database images.

In both algorithms, the query image and database images are compared using similarity measure of Euclidean distance and predetermined first and second level thresholding.

Results for both the algorithms are shown in Table-II and Table-III along with the performance evaluation parameters precision and recall in chart – I and Chart- II.

While observing the values of precision and recall for same set of query images, precision- 0.55, recall- 0.17 and precision 0.63, recall- 0.2 in Table – II and Table-III respectively we found that both parameters are showing good performance of second algorithm i.e. Kekre's transform over row and column variance vectors.

It can be concluded that in this case the texture feature has proved its best through the second algorithm of Kekre's transform over row column variance vectors.

We can also conclude that even though the database is having variety of images still the system is performing better in terms of precision for both the approaches.

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